UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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Screening-Level Human Health Risk Assessment
ESSROC Cement, Logansport, IN
RCRA Permit Part B

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I. Background

A. Overview

The United States Environmental Protection Agency (EPA) Region 5, RCRA Programs Section performed a risk assessment on the ESSROC Cement facility located in Logansport, Indiana. The ESSROC facility has two kilns capable of burning hazardous waste to produce cement.

A human health risk assessment is a methodological framework that we use to evaluate the potential for significant carcinogenic risks and non-carcinogenic public health hazards to occur from exposure of humans to toxic chemicals in the environment. We conducted the risk assessment in accordance with the EPA 2005 guidance "Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities." EPA performed the assessment using Title V MACT emission standard concentrations converted to emission rates in order to determine if these limits are protective of human health.

The EPA determined the RCRA permit would need to include annual feed limits of mercury containing wastes to be protective of human health.

B. Introduction

This report presents the results of a risk assessment conducted as part of an evaluation of the ESSROC Cement facility. The EPA conducted this evaluation to provide additional information relevant to a proposed permit renewal decision.

In this document, we refer to the analysis as a risk screening because the focus is only on those pollutants that the EPA believes to have a likelihood of exceeding accepted levels of cancer risk or chronic toxicity at this time, based on the EPA's experience with previous risk assessments for hazardous waste combustors. It also is a screening in the sense that we make several simplifying conservative (protective) assumptions in the process of conducting the assessment.

At this time, the EPA has focused specifically on the potential health impacts of chemicals and circumstances that relate to emission limits established by the Hazardous Waste Combustion - Maximum Achievable Control Technology Rule ("HWC-MACT" Rule). The chemical emissions assessed are polychlorinated dibenzodioxins and polychlorinated dibenzofurans ("Dioxins") and toxic or carcinogenic metals all regulated pursuant to 40 CFR Part 63 Subpart EEE (i.e., HWC-MACT Rule).

C. The HWC-MACT Rule

Hazardous waste incinerators, such as the ESSROC facility in Logansport, Indiana, are regulated under the Resource Conservation and Recovery Act (RCRA), which establishes a ‘‘cradle-to-grave’’ regulatory structure overseeing the safe treatment, storage, and disposal of hazardous waste. The EPA issued RCRA rules to control air emissions from hazardous waste burning incinerators in 1981, 40 CFR Parts 264 and 265, Subpart O. These rules rely generally on risk-based standards to assure control necessary to protect human health and the environment, the applicable RCRA standard. See RCRA section 3004 (a) and (q).

Hazardous waste incinerators also are subject to standards under the Clean Air Act (CAA). U.S. EPA promulgated the HWC-MACT Rule on September 30, 1999 (64 FR 52828). Because of legal challenges, U.S. EPA published interim standards for the HWC-MACT Rule on February 13, 2002 (67 FR 6792). On October 12, 2005, the EPA finalized replacement standards and made other additions and amendments to the HWC-MACT Rule (70 FR 59402). The HWC-MACT Rule created a technology-based national cap for hazardous air pollutant emissions from the combustion of hazardous waste at cement kilns. The rule regulates emissions of numerous hazardous air pollutants: dioxin/furans, other toxic organics (through surrogates), mercury, other toxic metals (both directly and through a surrogate), and hydrogen chloride and chlorine gas. For existing owners of hazardous waste incinerators, the RCRA Subpart O regulations generally no longer apply once the facility demonstrates compliance with the HWC-MACT Rule. [40 CFR § 264.340(b)]

Although the HWC-MACT Rule standards provide a high level of protection (i.e., they are generally protective) to human health and the environment, thereby allowing the EPA to nationally defer the RCRA emission requirements to MACT standards, additional controls may be necessary on an individual source basis to ensure that adequate protection is achieved in accordance with RCRA. Section 3005(c)(3) of RCRA provides the authority to impose additional conditions on a source-by-source basis in a RCRA permit if necessary to protect human health and the environment. Where site-specific factors beyond the HWC-MACT Rule standards are present, the EPA may decide to conduct a site-specific risk assessment (SSRA).

Some examples of site-specific factors include: a) a source’s proximity to a water body or endangered species habitat, b) repeated occurrences of contaminant advisories for nearby water bodies, c) the number of hazardous air pollutant emission sources within a facility and the surrounding community, d) whether or not the waste feed to the combustor is made up of persistent, bioaccumulative or toxic contaminants, e) and sensitive receptors with potentially significantly different exposure pathways (70 FR 59505).

D. Summary of Site-Specific Factors Relevant to the Potential Risk from the ESSROC Facility

The EPA considered a number of site-specific factors in evaluating whether compliance with the standards of 40 CFR Part 63, subpart EEE alone at the ESSROC facility would be protective of human health. The following is a summary of those factors:

- Particular site-specific considerations such as proximity to receptors: (such as schools, hospitals, nursing homes, day care centers, parks, community activity centers, or other potentially sensitive receptors), unique dispersion patterns, etc.

  France Park is approximately two and one-half kilometers from the ESSROC facility combustion stack. The park has two lakes - Old Kenith Stone Quarry Lake and Lake Trimer. These lakes are mostly used for recreational fishing. According to the France Park staff and the Indiana State Department of Health 2010 Fish Advisory Report, there are no fish advisories for these two lakes.

- The identities and quantities of emissions of persistent, bioaccumulative or toxic pollutants considering enforceable controls in place to limit those pollutants;

  The ESSROC facility emits, among other pollutants, dioxin, a known human carcinogen, and toxic and carcinogenic metals, including arsenic, beryllium, chromium, lead, cadmium, and mercury. Emissions of these pollutants are limited under the HWC-MACT Rule. This risk screening assesses the protectiveness of the corresponding HWC-MACT Rule emission standards for the ESSROC facility.

- The identities and quantities of other off-site sources of pollutants in proximity of the facility that significantly influence interpretation of a facility-specific risk assessment;

  We did not find any reports of elevated soil-lead levels in the communities surrounding the ESSROC facility. The EPA did not consider the presence of elevated levels of lead in the communities surrounding the ESSROC facility in assessing the incremental added risk that could be posed by the emission of lead from the ESSROC facility at the HWC-MACT Rule emission standard.

- The volume and types of wastes, for example wastes containing highly toxic constituents;

  The ESSROC facility incinerates a significant quantity of hazardous waste. According to its NESHAP Air Permit Notification of Compliance dated February 2010, the ESSROC facility has a Maximum Total Waste-Derived Fuel Flowrate limit for one-kiln operation at 14.5 tons per hour, or approximately 127,020 tons per year.

- Adequacy of any previously conducted risk assessment, given any subsequent changes in conditions likely to affect risk;

  This risk screening revises the analysis made in the original 2003 risk screening. The earlier analysis did not consider the potential effects from mercury on fishers at the nearby France Park lakes. The previous analysis did not consider the application of the HWC-MACT Rule emission standards**.** In addition, this analysis incorporates dry gas deposition of divalent mercury, and includes an updated mass balance calculation pertaining to mercury methylation.

E. Components of the Site-Specific Risk Assessment Process

The foundation for the risk screening methods described in this report is consistent with well established chemical risk assessment principles and procedures developed for the regulation of environmental contaminants. Application of these guidelines and principles provides a consistent process for evaluating and documenting potential health risks associated with environmental exposures. The risk assessment process used by federal regulatory agencies and applied in this screening is essentially that described by the National Research Council [1], and consists of the following four components:

- Hazard identification, in which the chemical substances of concern in emissions from the facility are identified and data relevant to the toxic properties of these substances are compiled, reviewed, and evaluated;

- Dose-response evaluation, in which the relationship between dose and response is evaluated for each chemical of potential concern to derive toxicity values that can be used to estimate the incidence of adverse effects occurring at different exposure levels;

- Exposure assessment, in which potential exposure pathways are identified and measures of chemical exposure (e.g., concentrations for the various environmental media, or doses) are estimated for the potential exposure pathways, based upon various exposure assumptions and the characteristics of the population receiving the exposure; and,

- Risk characterization, in which numerical estimates of risk are calculated for each substance by each potential route of exposure using the toxicity information and the exposure estimates.

F. Methodology Used for This Evaluation

(1) Risk assessment guidance and software computation model

The general model for the risk assessment analysis is contained in the EPA *Final Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities*; *EPA520-R-05-006* ("2005 combustion risk guidance"). The EPA chose this model for this risk screening because it is peer-reviewed and incorporates an opportunity to use site-specific data. The 2005 combustion risk guidance outlines a comprehensive procedure for calculating estimated environmental media (e.g., air, soil, vegetables, fish, meat) concentrations, human intake rates, and health risks due to the emission of chemicals from combustion stacks. Here are the basic steps in running the model for a facility:

a) Identify the chemicals of concern;

b) Collect facility-specific stack data (e.g., stack height, gas exit velocity, building dimensions) and local meteorological data; use this data as inputs for the EPA's AERMOD air dispersion/deposition model;

c) Collect data on local land use (residential locations, agricultural locations, fishable water bodies) and map this data in reference to facility location;

d) Combine chemical-specific emission rates with the air dispersion model to calculate chemical-specific air concentrations and deposition rates for multiple receptor points around the facility;

e) Combine chemical-specific air concentrations and deposition rates with fate and transport algorithms to calculate chemical concentrations in environmental media (soils, plants, vegetable crops, livestock and fish);

f) Combine human intake rates of environmental media (air, soil, plants, vegetable crops, etc.) with estimated chemical concentrations in environmental media to determine chemical doses (i.e., intake per unit time) for each applicable exposure pathway;

g) Combine the chemical doses with chemical-specific toxicity factors (e.g., cancer slope factors, Reference Doses) to calculate a Cancer Risk for potentially carcinogenic chemicals and a Hazard Quotient for potentially toxic chemicals;

h) Sum the Cancer Risks and Hazard Quotients for each chemical across the applicable exposure pathways;

i) Sum the Cancer Risks and Hazard Quotients ("HQ") for each chemical to obtain the total Cancer Risks and Hazard Index ("HI", the sum of the HQs) for all chemicals.

Because the evaluation of multiple chemicals, multiple exposure pathways, and multiple fate and transport processes is a very challenging computational exercise, we used a computer software program to accomplish running the risk assessment model for each emission point/stack. For this project, we used the software system called *Industrial Risk Assessment Protocol - Human Health v.4.5.5* (IRAP-h View^{TM}). Lakes Environmental Software (Waterloo, Ontario, Canada) developed this software package (abbreviated as "IRAP" in this report). IRAP-h is a Microsoft Windows application expressly designed to follow the recommendations, chemical-specific parameters, and fate and transport algorithms given in the EPA's 2005 combustion guidance. One can obtain more information on this model at the web site: <http://www.weblakes.com/iraph.html>

The major features of the IRAP system are its ability to: a) guide the user through the step-by-step process recommended in the 2005 combustion guidance; b) simultaneously calculate risk values (cancer risks and hazard quotients) for multiple chemicals emitted from a single source or from multiple sources at multiple locations; c) eliminate the need to perform hand calculations and write multiple interconnected computation spreadsheets; d) import air dispersion plot files containing the output from the AERMOD air dispersion/deposition model runs; e) provide a graphical display of the air dispersion model receptor grid mode locations; f) directly import Geographic Information System ("GIS") generated land use/land cover data (e.g., residential, farming, and water body locations); g) define the perimeter of water bodies and water sheds using a polygon drawing tool; and h) define an area of concern by selecting the receptor grid nodes that represent the highest modeled air dispersion model values.

Attached to this report are listings summarizing the non-default assumptions the EPA set in the IRAP model for this revised screening. Default assumptions incorporated in the model are as detailed in the 2005 EPA document *Final Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities*, which is available at: <http://www.epa.gov/epaoswer/hazwaste/combust/risk.htm> .

(2) Major site-specific exposure model assumptions

The following is a summary of the key exposure modeling assumptions employed in the analysis:

a) Exposed receptor - the EPA assumed the individuals who could be exposed to contaminants to be local adults and children who could reside near the ESSROC facility. An adult is a person of at least 18 years of age who, by definition, could be exposed to contaminants for an Exposure Duration of 30 years. A child is a person up to age 7, who could be exposed to contaminants for an Exposure Duration of 6 years. The EPA used other required exposure factors for adults and children from the 2005 combustion risk guidance.

b) Receptor locations - the EPA assumed individuals potentially exposed to contaminants to reside in the area outside the ESSROC facility boundary. The Receptor Areas for all receptor scenarios is the 10-by-10 kilometer air-dispersion grid surrounding the facility. This procedure adds conservatism to the risk screening.

c) Exposure pathways - the EPA assumed the potentially exposed individuals have contaminant intake from a combination of pathways. These can be summarized as inhalation of contaminants as vapors and particles, incidental soil ingestion and consumption of home-grown garden vegetable produce. The EPA modeled each of these exposure pathways as occurring at the highest impact points in the receptor location. In addition, the EPA assumed some individuals to ingest fish harvested from the lakes at the France Park Lakes. The EPA assumed these individuals to be local residents who fish at a local waterbody and consume some of their locally caught fish. The EPA also modeled the scenario of adult and child farmers. The 2005 combustion risk guidance explains these exposure pathway scenarios and the required intake parameters in detail.

d) Waterbodies and Watersheds – The EPA researched the waterbody and watershed parameters from phone calls to France Park employees and online searches.

e) Air-Dispersion Modeling - The EPA performed air dispersion modeling with site-specific information from ESSROC. This is detailed in EPA report *Dispersion Modeling of Stack Gases for ESSROC Cement, Logansport, IN*, April 12, 2012.

f) Mercury Speciation – The EPA determined mercury stack-speciation parameters fromsite-specific information from ESSROC. This is detailed in EPA report *Dispersion Modeling of Stack Gases for ESSROC Cement, Logansport, IN*, April 12, 2012.

g) Emission Rates – The EPA derived the risk-assessment emission rates from the HWC-MACT stack gas concentrations and site-specific information from ESSROC. These calculations are detailed in the EPA report *Dispersion Modeling of Stack Gases for ESSROC Cement, Logansport, IN*, April 12, 2012. The table below summarizes the emission rates.

CAS Number	COPC Name	Emission Rate (g/s)
1746-01-6	TetraCDD, 2,3,7,8-	6.48E-09
18540-29-9	Chromium, hexavalent	1.82E-03
7439-92-1	Lead	1.07E-02
7439-97-6	Mercury	7.78E-06
7440-38-2	Arsenic	1.82E-03
7440-41-7	Beryllium	1.82E-03
7440-43-9	Cadmium	1.07E-02
7487-94-7	Mercuric Chloride	2.07E-03

(Note: Total mercury emission rate is 3.89E-03 g/s.)

h) Cancer and Hazard Thresholds - In the EPA's *Implementation of Exposure Assessment Guidance for RCRA Hazardous Waste Combustion Facilities*, the EPA recommends that results of risk assessments conducted for hazardous waste combustor should be compared to a maximum cancer risk incremental increase target value (from metals at full permitted emission rates) of 1 in 1,000,000 (1.0E-06). That same criterion is used in this screening. In addition, risk assessments for hazardous waste incinerators have also typically calculated a hazard quotient ("HQ") from each metal and compared the results to the number 0.25. That criterion was also used in this risk screening. These combined criteria (for cancer risk and hazard quotient) are used here as indicators of whether or not human health is adequately protected, based on historical health risk benchmarks typically recommended by the EPA.

II. Findings of the Risk Assessment

A. *Dioxins*

The air dispersion modeling, fate and transport in the environment, and estimation of cancer risk and toxic hazard are based on the dioxin emission rate corresponding to the respective HWC-MACT Rule allowable emission limit. Under this approach, if an unacceptable cancer risk and/or toxic hazard were predicted for dioxin emitted at the HWC-MACT Rule limit, then the EPA would recommend site-specific RCRA permit limits and monitoring requirements.

The HWC-MACT Rule dioxin emission limit for existing hazardous waste cement kilns is given as a concentration in the stack gas: "emissions in excess of 0.20 ng TEQ/dscm corrected to 7 percent oxygen" (40 CFR §63.1203(a)(1)(I)). In the event that ESSROC is allowed to emit at 0.40 ngTEQ/dscm, the cancer risk and hazard index from dioxin would double. TEQ means the international method of expressing toxic equivalents for mixtures of dioxin and furan congeners as defined in "U.S. EPA, Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-dioxins and -dibenzofurans (CCDs and CDFs) and 1989 Update (March 1989)". Dioxin-TEQ is based on 2,3,7,8 - TCDD, which is the most toxic congener of the Dioxin group.

The Adult and Child Fisher scenario results are higher than the Resident and Farmer scenarios. The predicted adult and child risks and hazards results for a local fisher are presented in the table below. Because these risk results for Dioxin-TEQ are well below the action level of 1.0E-6 (1 in 1,000,000), the EPA is not recommending that any further reductions in Dioxin emissions should be required through a site-specific RCRA permit limit.

B. Toxic/ Carcinogenic Metals

The HWC-MACT Rule regulates emission concentrations of the metals arsenic, beryllium, chromium, lead, cadmium, and mercury because of the Agency's findings, as discussed in the preamble of that rule, that these metals present a greater potential threat than others generally emitted from a hazardous waste combustor. The preamble further concludes that emissions of the other toxic and carcinogenic metals will be adequately restricted via the particulate emission limit contained in the Rule because almost all toxic and carcinogenic metals would be emitted as solid particulate matter. Therefore, a limit on particulate matter will serve as an overriding limit on the total emission of all other metals. However, because the HWC-MACT Rule specifically considers arsenic, beryllium, chromium, lead, cadmium, and mercury to be a potentially greater threat, we have included them in this risk screening.

(1) *Lead*

The EPA analyzes the potential health impact of exposure to emissions of the metal lead under a different approach than other metals. This approach predicts whether there are potential increases in blood-lead level in a subgroup of the population (i.e., children) expected to have an enhanced sensitivity to lead exposure. The child-blood lead level can be compared with a level known to be associated with protection from adverse developmental neurological effects of lead exposure. The EPA analyzed the potential lead deposition to soil from the facility.

This screening risk assessment demonstrates that there will be minimal predictable amount of lead deposition to soil from the ESSROC facility. The model predicts that after 30- years of operation, the maximum increase in soil- lead concentration is 1.73E-05 mg/kg.

(2) Other Metals

The HWC-MACT Rule metals emission limits for existing hazardous waste incinerators at 40 CFR § 63.1203(a) are given as concentrations in the stack gas as follows:

Semi-volatile Metals - lead and cadmium (Pb and Cd): 330 µg/dscm, combined emissions, corrected to 7% oxygen.

Low Volatility Metals - arsenic, beryllium, and chromium (As, Be and Cr+6): 56 µg/dscm, combined emissions, corrected to 7 percent oxygen.

Mercury (Hg): 120 µg/dscm corrected to 7 percent oxygen.

Presented below are the results from the risk assessment. The fisher scenario results are greater than the residential and farmer scenarios. The listed cancer risk and hazard index values account for the combination of possible exposure pathways to an Adult and Child receptor as described above in the Methodology section.

Cancer Risk and Hazard Quotient Results

	Fisher Child		**Fisher Adult**	
Contaminant	**Cancer Risk**	**Hazard Quotient**	**Cancer Risk**	**Hazard Quotient**
Arsenic	1.39E-08	8.22E-05	5.57E-08	7.50E-04
Beryllium	3.99E-09	9.94E-04	1.99E-08	9.82E-04
Cadmium	3.96E-08	2.26E-03	2.03E-07	2.33E-03
Chromium (VI)	1.99E-08	2.62E-03	9.97E-08	2.52E-03
Mercuric chloride	NA	2.19E-03	NA	8.20E-04
Mercury	NA	2.86E-07	NA	2.76E-07
Methyl mercury	NA	1.79	NA	2.55
Dioxin – TEQ	1.67E-08	2.78E-03	1.10E-07	3.67E-03
NA - Not Applicable; available information not sufficient to classify contaminant as a carcinogen				

From the above Table, the EPA draws the following conclusions:

Mercury

From the standpoint of risk assessment, mercury deposition and runoff to water bodies is a concern primarily because of the conversion of mercury to methylmercury within the water column. Methylmercury has a high potential for bioaccumulation and bioconcentration into aquatic species and fish.

The EPA follows the risk management guidelines specified in the EPA's *Implementation of Exposure Assessment Guidance for RCRA Hazardous Waste Combustion Facilities*, which states that any one facility should contribute no more than HI = 0.25 under a reasonable maximum exposure scenario. Accordingly, the EPA would recommend that the annual total stack emission of mercury be restricted to result in a total HI equal to or less than 0.25.

Lead

Under the scenario of lead emissions at the full MACT concentration limit, no additional limits are necessary at this time.

Cadmium

Under the scenario of cadmium emissions at the full MACT concentration limit, no additional limits are necessary at this time.

Hexavalent Chromium

Under the scenario of hexavalent chromium emissions at the full MACT concentration limit, no additional limits are necessary at this time.

Beryllium

Under the scenario of beryllium emissions at the full MACT concentration limit, no additional limits are necessary at this time.

Arsenic

Under the scenario of arsenic emissions at the full MACT concentration limit, no additional limits are necessary at this time.

III. Conclusions

The EPA conducted a screening human health risk assessment for the ESSROC facility in Logansport, IN. The risk assessment calculated potential risks based on contaminant emissions at the existing regulatory limits for stack emissions of dioxin and toxic/carcinogenic metals, which have also become compliance limits for the ESSROC facility. In comparison to the frequently recommended risk management benchmarks of HI = 0.25 and cancer risk = 1.0 E-6 for each pollutant, the following recommendations are made with respect to further emission limits beyond the HWC-MACT concentration limits:

Dioxins: No additional limits necessary.
Mercury: Restrict total annual stack emissions such that total HI is equal to or less than 0.25.
Cadmium: No additional limits necessary.
Lead: No additional limits necessary.
Chromium: No additional limits necessary.
Beryllium: No additional limits necessary.
Arsenic: No additional limits necessary.

Appendix

IRAP Reports